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TESTIMONY

RAND

Assessing Natural Gas and Oil Resources

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June 24, 2003

Before the Committee on Resources Subcommittee on Energy and Mineral Resources

This statement is based on a variety of sources, including research conducted at RAND. However, the opinions and conclusions expressed are those of the author and should not be interpreted as representing those of RAND or any of the agencies or others sponsoring its research.

U.S. House of Representatives

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Testimony of Debra Knopman

Associate Director of RAND Science & Technology

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Thank you, Madam Chairman, for the opportunity to testify before the Subcommittee on Energy and Mineral Resources about methods of assessing oil and gas resources.

I am Associate Director of RAND Science and Technology, a Senior Engineer at RAND, and a member of the study team for RAND's recently released final report "Assessing Natural Gas and Oil Resources: An Example of a New Approach in the Greater Green River Basin." This study was funded by the William and Flora Hewlett Foundation.

In April 2002, I appeared before this committee with interim findings. In our testimony, I reviewed existing resource assessment methods and presented a general framework for a new approach to assessing natural gas and oil resources. Today, on behalf of my co-authors, I offer our completed research, including the results of applying this new approach to the Greater Green River Basin in southwestern Wyoming.

OVERVIEW

Natural gas and oil resource assessments have historically focused on the amount of resource in the ground that could be extracted, based on assumptions about available drilling technologies. Our new methodology builds on these traditional assessments by adding economic and environmental considerations, such as how much resource might be recoverable at what cost, and how much resource is associated with lands having different environmental values.

The primary objective of our research is to help governmental officials and other stakeholders make more informed choices related to land use planning, design of energy policies, and energy development and fuel utilization planning. For example, the additional economic and environmental information generated by our approach -- overlaid on maps of the technically recoverable resource -- can help public land managers distinguish energy potential among different areas and set priorities among areas based on multiple -- and often competing -- public objectives.

This new approach can help federal and state land managers and policymakers at all levels plan strategically for long-term resource use. It is worth noting that current law requires that this planning take place; it just happens to take place now in the absence of this richer source of information. We are

suggesting that the existing planning process could be substantially improved by systematically introducing economic and environmental criteria consistent with the same geological framework used to represent the technically recoverable resource.

RAND'S PERSPECTIVE ON THIS RESEARCH

As in all our work, RAND's interest in this issue is to improve decision-making through research and analysis. We are an independent non-profit organization, dedicated to producing objective, non-partisan analysis. Our publications are subjected to rigorous peer review and quality assurance during which we actively seek internal and outside experts to critique our work. The research upon which this testimony is based has been through this quality assurance process.

RAND does not have a position on whether oil and gas exploration and development should proceed on currently restricted federally managed lands. Instead, our interest is in the quality, relevance, and transparency of the technical information that surrounds the public debate on future development. We also seek to encourage an expansion of the discussion regarding prospective exploration and development beyond the particular access restrictions applied to federal lands. We believe that improved public understanding of the range of estimated costs and impacts of development and associated infrastructure, under different technology and economic assumptions, will contribute significantly to the debate on national energy and land management policies.

We fully recognize that there are legitimate questions about the appropriate federal role in examining the economics of exploration and development scenarios. Our proposed approach is not meant to replace industry's detailed, site-specific economic evaluations or federal land managers' existing environmental assessment and permitting processes. Rather, it is meant to provide decisionmakers with a more comprehensive assessment of bounding ranges of resource availability at the regional and subregional scale. We believe our proposed methodology would enhance current efforts by the BLM and other federal land managers to communicate more effectively and clearly the economics and environmental implications of their actions. We are simply making a case for more comprehensive information in the policy process.

OVERVIEW OF FINDINGS

Our chief point can be summarized as follows: There is an ongoing need for improvements in the way we think about how to value energy resources and ways we can incorporate this valuation into land use and other decisionmaking. Our study focuses on this need, specifically for natural gas and specifically for federal land in the Rocky Mountain West.

Decisions about potential development of oil and gas resources are particularly relevant now. Natural gas demand in this country has been increasing for the last 15 years and is expected to increase substantially in the next 20 years. Most states and regions are currently in the process of planning for considerable future dependence on natural gas as their dominant electricity-generating fuel. With demand rising, much attention has focused on strategies to increase domestic production. As a result, decisionmakers and the public would benefit from a more comprehensive view of prospective costs and availability of long-term domestic supplies of natural gas and oil.

Further, as domestic production of gas increases, federal land managers, particularly the Bureau of Land Management and the Forest Service, confront with increasing frequency complex and sensitive development decisions%decisions that can have far-reaching and long-term effects. As they approach future land use questions, an assessment approach that allows for more strategic decisionmaking is highly desirable. We thus propose a methodology that incorporates a fuller array of the issues federal land managers must face, including costs associated with production as well as environmental considerations that may have an impact on additional costs of exploration and development.

A MORE COMPREHENSIVE ASSESSMENT ALLOWS FOR MORE STRATEGIC AND LONG-RANGE DECISIONMAKING

The rapid increase in domestic natural gas production has heightened the necessity for the country's land management agencies to take a strategic view of federal land use decisionmaking—one that allows them to understand the differences between resources in different areas and thus to prioritize lands being evaluated for development. Under current practices by the Bureau of Land Management and the Forest Service, resource management plans required by the Federal Land Management and Planning Act may remain in place for on average about 15 years before being updated. In the meantime, many small-scale decisions related to individual applications to drill are made based on out of date planning assumptions about the status of the energy and other resources throughout the region. Current practice leaves little room for land managers to set internal priorities on deploying their own resources to further public objectives, including increased domestic energy production. Our primary goal was to develop a consistent and technically defensible means of bringing in new information about economics and environmental measures into the

strategic planning process for the purpose of improving the long-range and large-scale view of public land use decisions.

This new approach is designed to offer a larger picture than traditional gas and oil resource assessments. The function of current assessments is to provide decisionmakers with a scientifically informed estimate of the quantity and spatial extent of the resource. These assessments focus on what is commonly called the “technically recoverable resource,” or the amount of the resource that is estimated to be recoverable given certain assumptions about exploration and production capabilities. Resources are evaluated in terms of geological criteria and technical feasibility of recovery, but without economic or other considerations. These estimates, therefore, are not intended to indicate how much resource will likely be developed and at what cost.

HOW THE NEW APPROACH WORKS: THE GREATER GREEN RIVER BASIN CASE STUDY

As a means of demonstrating how our new methodology works, we used it to assess natural gas resources in the Greater Green River Basin. We believe these results are instructive for developing the methodology further and providing insights that may help inform strategic energy resource planning in this basin. We chose this region because its characteristics apply to multiple areas throughout the intermountain areas of the Rocky Mountains. Due to its relative richness in hydrocarbon resources, particularly natural gas, this region has been under intense scrutiny in recent years as efforts increase to find domestic sources of gas and oil.

National resource assessments indicate that the Rockies contain approximately 15 percent of the nation’s technically recoverable future natural gas supply. Further, in the Rockies, 60 percent of the technically recoverable gas underlies federal land, compared to just two percent in the onshore areas of Texas and the Gulf Coast states. Thus, growth in production in the Rockies means that energy-related land use decisions will increasingly become the responsibility of federal land managers.

Likewise, in this region, gas occurs in diverse range of deposit types and depths, resulting in a large range of costs and demonstrating the need for a more comprehensive assessment approach.

As a first step, we mapped the spatial distribution of the technically recoverable resource in the Greater Green River Basin. We looked at three different estimates: the 1995 U.S. Geological Survey Assessment, the “conventional technology” estimate from the National Petroleum Council (NPC), and the “enhanced technology” estimate from the NPC. For mapping purposes, we disaggregated the geological units identified by USGS as containing substantial resource (known as “plays”) into smaller “subplays.” This enabled us to provide a more refined estimate of costs, particularly capturing differences in drilling costs related to the depth of the deposits. Then, we generated production cost curves for proved reserves, reserve appreciation, and undiscovered resource in each subplay in order to determine the resource available at different costs. We estimated separate costs for each resource unit, resource category, resource type, and depletion increment, eventually formulating separate costs for over 1,200 distinct analysis units throughout the basin. Using continuous cost curves, we summed up the amount of gas that could be produced at costs beginning with zero and extending up to different discrete prices.

Our analysis found that, depending on the base technically recoverable resource estimate used, approximately 35 to 45 percent of natural gas in the Greater Green River Basin could be produced profitably produced at less than \$3 per million British Thermal Units (MMBtu), which is similar to recent prices in Wyoming. Up to 65 percent could be profitably produced if the market price were \$5 per million MMBtu.

Importantly, our analysis showed that the fraction of technically recoverable gas that is economically recoverable at a given price varies substantially from place to place; for example, concentrations in some areas drop off much more quickly than in others as the price decreases. Such a result highlights the usefulness of combining economic and spatial analyses: When looking at specific areas, the concentrations of economically recoverable resources do not necessarily correlate directly with the concentrations of technically recoverable resources. In other words, what is technically recoverable is not always economically desirable under assumed market conditions.

This spatial-economic analysis thus provides information not currently available to help federal land managers distinguish gas resources in different areas. By using transparent economic and other quantitative criteria, the methodology enables decisionmakers to establish a credible basis for more spatially refined priorities.

The next stage in our approach overlays these findings with environmental considerations. Specifically, our next analytical step seeks to factor in the environmental attributes of the resource by distinguishing resources according to the characteristics of the land it occupies. It is important to point out that this part of the methodology does not function as, or substitute for, an environmental impact assessment. Rather, it is a first attempt at what we call an environmental characterization: a description of some relevant environmental

measures and a classification of the lands and associated resources according to these measures. Eventually, an environmental impact assessment would have to occur before actual drilling activities begin, but this characterization provides an initial framework for the process, both at a larger scale and at an earlier stage in the planning process.

In this analysis, we examined seven environmental measures: 1) Terrestrial vertebrate species richness; 2) Proximity to sensitive species observed locations; 3) Surface water and riparian habitat zones; 4) Proximity to human settlements; 5) Aquifer recharge rate; 6) Depth to groundwater; 7) Surface slope. The first three measures address primarily ecosystem quality, the fourth represents issues related to human use of the area, and the final three measures examine primarily water quality. We also considered existing federal land access restrictions. Measure values were grouped or "binned" and maps of the spatial distribution of the lands with different measure values were then generated. It is important to note that the cut-offs between different bins are statistically rather than empirically based. The relationship between environmental measures and sensitivity to environmental impact is complex and developing this relationship is beyond the scope of this approach. Our statistically derived bin values do, however, provide a relative sense of environmental concern and so do offer some useful guidance. However, because these values are not based on empirically-derived relationships between gas and oil development activities and potential environmental impacts, they say little about actual environmental risk and in that sense the environmental measures need to be developed further as the methodology becomes more comprehensive.

Our analysis indicates that, for the most part, the concentrations of economically recoverable gas exist in areas of relatively lower potential environmental concern—at least in terms of the environmental measures we considered. For instance, 18 percent of the economically recoverable natural gas is in areas with predicted species richness above the median value and 11 percent is in aquatic or riparian areas. Less than eight percent of the gas occurs within close proximity of human settlements. Of the water quality measures, only eight percent occurs in areas with slopes greater than 25 percent, and areas with high aquifer recharge rates and shallow groundwater contain, respectively, nine percent and 12 percent of the gas in the basin.

I should note that in the specific case of the Greater Green River Basin, the measures related to ground water quality may not be as important as in other areas. This would be the case as long as the state of Wyoming enforces their current requirement that no drilling waters are discharged at the surface, but rather are reinjected into the subsurface. However, for purposes of illustrating a broader range of environmental attributes, we included these ground water measures in our analysis.

As with the economic evaluation, however, environmental overlay results for certain areas within the basin differ from the basin-wide average values. Indeed, we found some areas with relatively high gas densities that do coincide with riparian habitats, high terrestrial vertebrate species richness, and shallow groundwater. Such findings may be particularly relevant in areas such as north of the LaBarge Platform, which may appear promising judging by the economic analysis alone but may present more complexity -- and hence more cost -- when one considers its environmental attributes.

Of course, the fact that an area has specific environmental characteristics does not necessarily mean these characteristics will be negatively affected by development. Still, our results suggest that some lands might be less attractive than other lands for development. For example, there may be more costs associated with mitigating potential impacts on lands close to surface water resources. This information would be useful to public land managers who may need to prioritize their efforts in permitting lands for exploration and production.

We have highlighted aspects of natural gas resources in the Greater Green River Basin that may not be directly evident from technically recoverable resource assessments. However, the value of this approach is expected to be even more evident when it has been applied to all the basins in the Rocky Mountains and eventually to all basins in the country. Just as a basin-wide evaluation using a consistent methodology allows federal land managers to compare and prioritize areas within the Greater Green River Basin, a Rockies-wide evaluation will allow these managers to make the same type of comparisons and prioritizations among areas within different basins.

Ultimately, we believe the results generated from this approach can provide decisionmakers with more robust information about natural resources that can help guide strategic resource planning, help prioritize difficult decisions that are being made about access to federal lands, and help understand the potential consequences of decisions.

As with any type of spatial analysis, the appropriate level of interpretation depends critically on the resolution of the underlying data. This is particularly evident in our study which is fundamentally limited by the quality and spatial resolution of the underlying geologic framework establishing the estimates of technically recoverable resource. The USGS and NPC estimates are not sufficiently resolved spatially to identify small, but possibly productive deposits. The Jonah field in Wyoming is frequently cited as an example of a small, but highly productive area that was "missed" by the experts. Our analysis, as any analysis at a similar

resolution, must therefore be used with the understanding that more detailed information may be needed to make decisions at the smaller scale.

RELATIONSHIP OF THE RAND METHOD TO THE EPCA STUDY

During the time we were developing our method, an interagency work group completed their study of the spatial distribution of access restrictions in the Rockies, including the Greater Green River Basin. The work group's report, known as the Energy Policy and Conservation Act (EPCA) study, took a fundamentally different approach from our study. The EPCA study pulled together a spatial analysis of access restrictions as they applied to the technically recoverable resource. These access restrictions are typically associated with environmental concerns, but they are inconsistently applied from region to region and state to state. Hence, they are a highly variable – and unreliable – measure of environmental assets. Further, by design, the EPCA study did not address issues associated with the costs of resource development at the wellhead or the infrastructure costs of transporting the resource to market.

FINAL COMMENTS

Given its capabilities, we believe our new methodology enhances the array of tools currently available. By linking economics and environmental characteristics with spatial analysis, it allows decisionmakers to consider relative priorities for development. It is also a flexible methodology that is applicable to other regions. For federal land use planners, it provides more information to weigh energy resource values, while also helping to identify areas with higher production potential. In turn, for energy planners, it offers information to help in the comparison of policy options and can guide fuel choices and import planning. Indeed, if this information were available for all basins in the region, electric utilities or state energy planners could plan their long-term resource use more effectively by having a more realistic view of availability based on production costs. Likewise, the Energy Information Administration could use this information in its price and supply forecasts. For other stakeholders, such as state authorities, utilities, and natural gas and oil producers, it can assist in estimating energy availability and in planning for power plant and transmission infrastructure investment. Finally, this approach can be used on the local level to forecast economic impacts, such as projected revenues and jobs brought about by these land uses.

It is important to note that this new approach is not meant to be the sole tool in any decisionmaking process. Instead, it is intended to be a part of a broader set of information sources that decisionmakers might use. Further, it is not intended to replace detailed economic or environmental analyses on specific leases. What it does offer, however, is a new means to treat economic costs and environmental characteristics as integral attributes of energy resources. We believe this approach will contribute to a richer debate and assist in the kind of long-term strategic planning needed to tackle these areas of growing concern.

This concludes my testimony. I welcome any questions you may have. Thank you.